

# Single Point Lesson – What is “World Class Maintenance”

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## World Class Maintenance Cost vs Typical (Source: Alcoa Mt Holly – John Day)

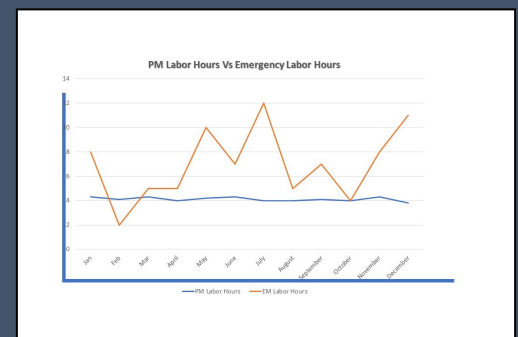
Metric	Typical	World Class
Maintenance cost/replacement asset value		
Maintenance cost must include labor (including overtime), materials, contract maintenance, and capital replacements, and maintenance (replacing worn-out assets because they were never properly maintained)	3.5–9%	2.0–3.0%
Maintenance materials cost/replacement asset value		
Maintenance materials cost must include material in storeroom stock plus material in other locations (maintenance shop, plant floor, etc.)	1.0–3.5%	0.25–0.75%

“World Class Maintenance requires all maintenance and reliability processes to be optimized, repeatable, and effective”

### 1. PM/PdM program is effective.



- PM/PdM is where the Proactive Maintenance Process begins; without it you cannot plan or schedule proactively.
- PM/PdM is focused on identification or prevention of specific “Failure Modes”
- PM/PdM effectiveness measured using Mean Time Between Failure (MTBF) by:
  - Site
  - Area
  - Asset
  - Equipment/Component
  - PM vs Emergency/Urgent Labor Hours
- Planning Process is effective. Measure by:
  - 15% Work is PM
  - 15% Work from PM results
  - 15% Work is PdM
  - 35% Work from PdM Results
  - 90% Planned Work



- ### 2. Definition: Percent of Planned Work; at the minimum, the following is required for a job to be defined as “Planned”:
- Repeatable procedure with specifications and standards

- Estimated labor hours by craft
- Step by Step Instructions (reduced human induced failures)

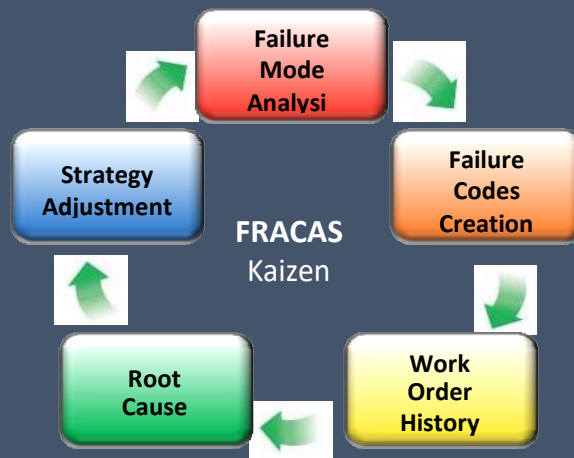
2-Rotor Miner – Inspect Shear Pin Plates			
Equipment Block ID:			
SeaRock Mine, 2-ROTOR MARIETTA MINERS			
Equipment Hierarchy:			
E560XXX Miner			
Project Description:			
2-Rotor Miner Front End Inspection			
Job Description:			
Inspect shear pin plates			
Frequency: Monthly			
Estimated Craft Hours: 1 x 1.0		Estimated Elapsed Time: 1.0	
Estimated Production Downtime:			
Originator:	Dave Stone	Origination Date:	03/12/2012
Owner:	Mine Maintenance	Version #:	1
Previous Version(s) Modifications:			
Approval:	DS	Version #:	1.0
Warnings:	Always use face shield over safety glasses when blowing off equipment Lockout procedure must be followed		
Cautions:	Failure to follow torque specs can result in equipment failure		
Personal Protective Equipment Required: Gloves, face shield, hearing protection			
Part # (Stores ID)	Part Description	Quantity	Quantity Description
Bolt bin	1/2" x 2" Gr. 5 socket head bolts	6	each
Consumables Needed:			
Degreaser, paper towels			
Special Tools Required:			
2' pry bar			
3/4" torque wrench			
Mobile/Special Equipment:			

2-Rotor Miner – Inspect Shear Pin Plates					
Required Departmental Coordination:					
Production shutdown / position / blow off equipment					
Other Procedures Referenced:					
Job Preparation / Lockout Procedure #XXX					
ID	Description	Craft	# of Crafts	Clock Hours	Craft Hours
1	Clean area to be inspected using compressed air or degreaser as required <b>Warning: use face shield when blowing with compressed air</b> <b>Warning: Ensure hydraulic pump drive motor is racked out:</b> <b>Tag test before proceeding</b>	Mech	1	0.2	0.2
2	Inspect shear pin plates	Mech	1	0.3	0.3
2-1	Visually check for cracks on shear pin plates Are any cracks evident Yes _____ No _____				
2-2	Insert 2' pry bar between plates to check for movement. Is any movement present? Yes _____ No _____				
3	Inspect sprocket	Mech	1	0.3	0.3
3-1	Visually inspect for: Cracks Yes _____ No _____ Broken Teeth Yes _____ No _____ Visible Signs of Wear? _____ If indicated, report findings below and to immediate supervisor for appropriate actions				
4	Inspect retainer cap	Mech	1	0.2	0.2
4-1	Visually inspect for broken bolts Are there any broken bolts? Yes _____ No _____				
4-2	If broken bolts are found, replace as required <b>Torque bolts to 80 ft. lbs</b>				

### Example of a Repeatable Procedure

- Emergency/Urgent Labor Hours account for 2% of total labor hours
  - Estimated time for work order execution
  - Parts Required
  - Potential parts identified and reserved
  - Parts kitted/staged (Planner is watching parts)
- Maintenance Scheduling is effective
  - Maintenance Scheduling requires maintenance, operations, engineers, etc. to agree on the Maintenance Schedule, by workorder, at least one week
  - Scheduling Compliance at least 85%, measured by labor hours
  - Scheduled Compliance is given to work completed on the day scheduled if it has been scheduled at least one week out
- Work Execution is effective
  - Measured by percent of Rework
- This process requires the following:
  - Job to be planned and scheduled
  - Repeatable procedures
  - Parts kitted/staged
  - Wrench time above 55%
  - Time estimated +/- 10%
- Work Order Close Out is effective
  - Over 100% of work orders are closed out to 100% to standard
  - Required Data Fields identified by Maintenance and Engineering Management

- Data fields are identified based on Metrics, Key Performance Indicators (KPI), and failure reporting required to manage a World Class Operation
- Failure Reporting, Analysis, and Corrective Action System (FRACAS) is functional and effective









This is the Continuous Improvement Process for Maintenance and Reliability, where decisions are made based on data in order to change a maintenance strategy, operating procedures, or

8. Reports are generated and acted upon based on specific criteria defined by Maintenance, Operations, and Reliability Management in order to mitigate or eliminate equipment failures.

At a minimum, the following reports are required:

- MTBF down to the component or part level
- Mean Time Between Repairs (MTBR)
- Rework
- Bad Actor Report (as defined by your organization)

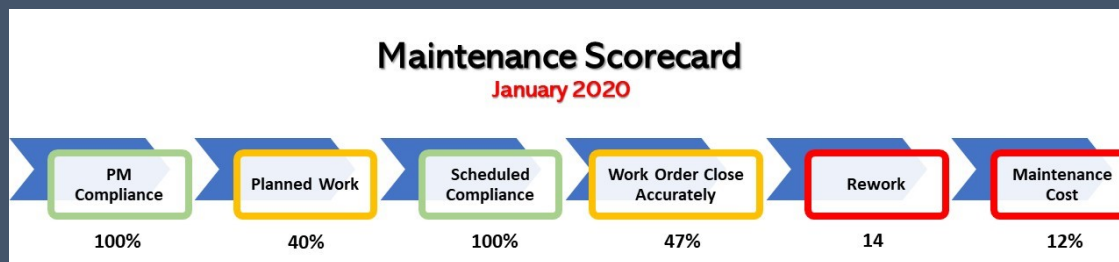
### Top 6 Dominant Failure Patterns for site, area, system

The six conditional failure probability patterns		UAL 1978	Broberg 1973	MSDP Studies 1983	SSMD 1993
Age Related \ Wearout	 <b>A.</b>	4%	3%	3%	6%
	 <b>B.</b>	2%	1%	17%	0%
	 <b>C.</b>	5%	4%	3%	0%
Evidence of wearout		11%	8%	23%	6%
Random \ No wearout	 <b>D.</b>	7%	11%	6%	0%
	 <b>E.</b>	14%	15%	42%	60%
	 <b>F.</b>	68%	66%	29%	33%
No evidence of wearout		88%	92%	77%	93%

- Ensure that the corrective maintenance strategy and approach is applied
- Verify that outages are needed and, if so, which equipment has a failure pattern that is age related and not random
- Dominant Failure Threads – which component/part fails the most as a result of the same cause across a site, line, asset  
 Example: Part – Bearings (123 failures) Cause: Lack of Lubrication (92% of the time) = Dominant Failure Thread



## 9. Measure the output of your Maintenance and Reliability Functions



Example Scorecard #1

Maintenance Scorecard			
	Best practice	10/12/2020	YTD
Maintenance Schedule Performance	>70%	62%	67%
Maintenance Break In Work	<15%	38%	33%
PM/PDM Work Scheduled	> 30%	18%	35%
PM/PDM Compliance	>80%	36%	67%
Notification Entered from PM/PdM find	1 for every 6 inspections	2	3
Equipment Not Available	Weekly	0	1.45
P1 Notifications	Weekly	12	11.43
Core Shift Mechanic	Weekly	4	3.95
Polymer Shift Mechanic	Weekly	9	6.22
No Information P1's (Still open)	Weekly	0	1.55
		Shift & Core worked on 1 P1 together	

Example Scorecard #2

## 10. Perform a Maintenance Assessment and create a Master Plan using the methodology: “Quick wins, Crawl before you walk and walk before you run”

### 1) Key maintenance and reliability process principles

**Calculation:** Identify the number of statements which you identified as yes and multiply this number by 10 (possible 150 points)

Questions	Yes/No
a) Does management have roles and responsibilities defined for all of the maintenance staff?	
b) Does management know and manage with leading key performance indicators?	
c) Are the work flow processes defined for all elements of the maintenance and reliability process such as planning, scheduling, work execution, etc?	
d) Has the critical assets been defined based on consequence and risk the business ensuring weighted values are assigned to determine asset criticality in areas such:	N/A
i) Safety	
ii) Environmental	
iii) Capacity	
iv) Cost	
v) Other criteria	
e) Has the management team defined the gap between current performance of the plant and desired performance and determined the financial opportunity identified?	
f) Is your current PM / PdM program on critical assets based on RCM Methodology (RCM, RCM Turbo, FMEA, etc)?	
g) Does your organization define failure based on functional failure of the asset?	
h) Does your organization have dedicated planner/schedulers?	
i) Does the whole organization accept responsibility for reliability?	
j) Does your organization use MTBF (Mean Time Between Failure) to determine the reliability of your assets?	
<b>Total “yes” answers times 10 =</b>	

### Assessment Example



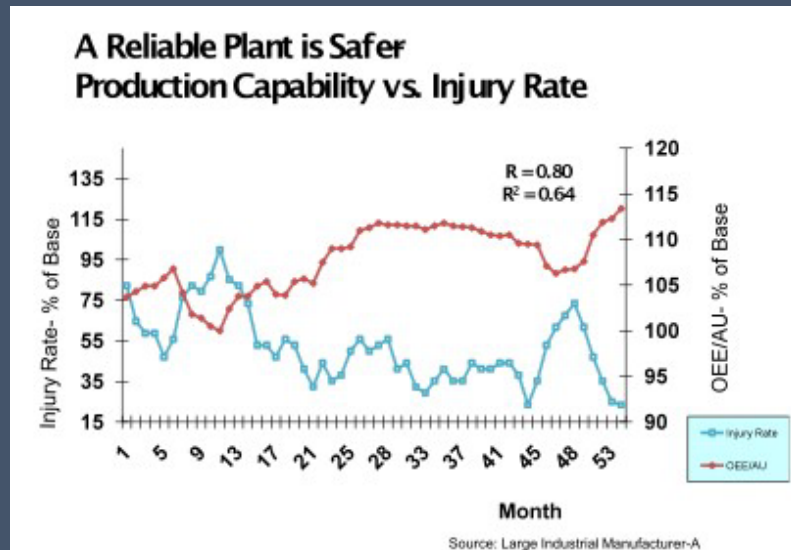
### Master Plan Example

## Conclusion

The journey to World Class begins with a plan which has been defined. The rewards are great and amazing.

These rewards include:

1. Lower Maintenance cost (Labor and Material)
2. Increase in Safety



3. Lower employee turnover
4. Customer satisfaction through lower cost and on time deliveries



## WORLD CLASS MAINTENANCE Inc.



Checkout our website for Maintenance/Reliability Best Practices information which may meet your needs,  
 with no email addresses required at: [www.worldclassmaintenance.org](http://www.worldclassmaintenance.org)

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